



Grade Level Texas Essential Knowledge and Skills (TEKS) by Content Area:

English Language Arts {2008}

Grade 4: 1; 2B; 11D; 13B; 15A; B; C; D; E; 17; 18C; 19; 20A; B; C; 21A; B; C; 22A; B; C; D; 25; 26; 27A; B; 29

Grade 5: 1; 2E; 9; 11A; B; C; D; E; 12A; B; 13A; B; 15A; B; C; D; E; 17; 18A; B; 19; 20A; 21A; B; C; 23A; B; 24A; B; C; D; E; 25A; B; 26A; B; C; D; 27A; 28; 29

Grade 6: 1; 2B; E; 12A; B; 14A; B; C; D; E; 17A; B; 18; 19A; 20A; B; C; 21C; 22A; B; 23A; B; C; D; E; 24A; B; 25A; B; C; D; 26A; B; C

Grade 7: 1; 2B; E; 12A; B; 14A; B; C; D; E; 16; 17A; B; 18A; B; C; 19A; 20A; B; 21; 22A; B; 23A; B; 25A; B; C; D; 26A; B; C; 27; 28

Grade 8: 1; 2B; E; 12A; B; 14A; B; C; D; E; 17A; 18A; B; C; 19A; 20A; B; 21; 22A; B; 23A; B; C; D; 24A; 25A; B; C; 26A; C; 27; 28

Science {2009}

Grade 4: 2A; B; C; D; E; F; 3A; 7C; 9B

Grade 5: 2A; B; C; D; E; F; G; 3A; 9A; C

Grade 6: 2A; B; C; D; E; 3A

Grade 7: 2A; B; C; D; E; 3A; 8C; 10A

Grade 8: 2A; B; C; D; E; 11A; B; C; D

Social Studies {2010}

Grade 4: 9B; C; 21B; C; D; 22A; B; C; D; E; 23A; B

Grade 5: 9A; B; 24A; B; C; D; 25A; B; C; D; E; 26A; B

Grade 6: 6B; C; 7A; B; 21A; B; C; D; E; 22A; B; C; D; E; 23A; B

Grade 7: 10A; 21A; B; C; D; E; F; G; 22A; B; C; D; 23A; B

Grade 8: 11B; 29B; E; D; 30A; B; C; D; 31A; B

Health

Grade 4: 1F; 3B; 5A; B; C; D; 6A; 8B; 11A; B; E

Grade 5: 1F; 4B; C; D; E; 7A; 8A; D; 9A; C; D; E

Grade 6: 3A; 4A; 5F; 6A; 7E; 11A; C; E

Grade 7/8: 3B; C; 4A; C; 5A; 6B; 9A; 1A; B; C; E; F

Beach Mysteries

Overview

Students learn how bacteria indicate the quality of beach water for swimming. They solve hypothetical problems and write persuasive essays on the topic of beach health.

Objectives

- ✿ Discuss the effects of harmful bacteria on beach swimming conditions.
- ✿ Diagram three reasons for beach contamination.
- ✿ Explain solutions for beach health problems.
- ✿ Write a persuasive essay about beach health.

Prerequisites

Units 2 and 3

Vocabulary

bacteria

single-celled microorganisms that break down organic wastes, making their components available for reuse.

sewage overflow

sewage that is discharged into waterways.

stormwater

water that accumulates on the ground during a rain event.

Environmental Protection Agency

a federal agency established to protect human health and the environment.

E. coli

bacteria (*Escherichia coli*) occurring in various strains, and living as harmless inhabitants of the human lower intestine, are used in public health as indicators of fecal pollution, or produce an intestinal illness.

Setting

Indoors/Outdoors

Materials

- ✎ pencils
- ✎ journals
- ✎ clipboards (if outside)

Background

Beaches are beneficial to shoreline communities, providing recreation, places to gather and beauty. It is important to keep them clean and healthy. Although this activity is about beach closings, emphasize to students that Texas beaches can be wonderful places for swimming and recreation. However, the number of beach closings due to bacteria issues is on the rise, so it's important that communities become informed about bacteria. The information in this activity should not stop students and their families from enjoying Texas beaches when they are open and healthy. On the contrary, this information should enable students and their families to better understand how to appreciate beaches and keep them healthy so they can be enjoyed.



Beach Closures

When bacteria levels are high, local health departments are forced to close beaches or declare swimming bans. As monitoring programs are implemented in communities, beach closings happen with increasing frequency.

Texas Beach Watch Program

The Texas Beach Watch Program contracts with local governments, universities and commercial laboratories to collect and analyze water samples and recommend, issue, and notify the public of beach advisories when coastal waters have elevated levels of the *Enterococcus* bacteria. The Texas General Land Office's Beach Watch website keeps the public informed with up to date information about water quality and safety tips for Texas' beaches at texasbeachwatch.com.

Health Issues

Beach closures are prompted because of the health risks posed by bacteria, which come from sewage overflows, untreated stormwater runoff, animal waste, boating wastes and malfunctioning septic systems. Sewage treatment plants in some large cities were not originally built for the

increased number of people that now live there. According to a 2004 study entitled *The Economic Costs of E. Coli Beach Closings*, for each day a beach is closed, communities can lose thousands of dollars in revenue.

When a beach is closed, people who use nearby shore areas for recreation—including divers and swimmers—are at risk when bacteria are present. Bacteria and other germs in contaminated sand and water can cause vomiting, diarrhea, stomachaches, nausea, headaches, fever, rashes, and pink eye.

Recreational water quality monitoring

Beaches are managed by local governmental agencies that try to keep the shoreline safe for human use. In many cases these agencies monitor the water quality by testing bacteria levels. When levels are too high, areas that have monitoring programs will close the beaches.

E. coli is the bacterium used to determine if a beach should be closed. It is found in human and animal feces and is commonly used for science experiments in thousands of schools and laboratories around the world. You have it living inside your intestines right now, as does every other human, and many other organisms. *E. coli* has hundreds of genetic variants; only a very few of these can make humans sick. The strain of *E. coli* that agencies look for during beach testing is not necessarily what makes humans sick, but it indicates the presence of fecal contamination (and possibly other pathogens that ARE harmful).

There is only one particular strain of *E. coli* harmful to human health, and it is relatively uncommon. However, *E. coli* is easy to test for and is an indicator of other potentially harmful bacteria that can exist under the same conditions. When *E. coli* is found in high levels, beaches are closed because bacteria harmful to human health may be present.



Activity

1. Ask for a show of hands to find out how many students in your group swim regularly at a Texas beach. Discuss as a class: Can beaches be dirty if there is no garbage to be seen? How? Take a few responses.
2. Are beaches in your area ever closed or do they have swimming bans? This depends on whether or not your area has a recreational water quality monitoring program. Beaches in some areas are closed when bacteria levels exceed Environmental Protection Agency standards.
3. Why does this happen? Create a list of ideas to assess students' prior knowledge about why beaches close. *Note: If beaches are not monitored or closed in your area due to high bacteria levels, let students know that this happens on Texas beaches in other areas.*
4. Use the background information to explain bacteria in general and E. coli in particular, and the health issues they present.
5. As a group, discuss the Beach Mysteries from the Journal Pages (Unit 4, Pages 6-7). Have students present their answers to each other. (Answers can be found on Unit 4, Page 4).
6. Create! After students have solved the Beach Mysteries, have them create and label a diagram that shows at least three to four ways bacterial pollution can get to the beach. Students should include solutions to the problems in their diagrams.
7. Discuss as a class: What are solutions to beach health issues? Have students share the responses in their diagrams. Remember that while monitoring can indicate that there is a problem, it doesn't identify or eliminate the source. Source elimination is the ultimate solution. How will students' knowledge of beach health issues change their future behavior at the beach?
8. As a follow up, have each student write a persuasive essay or letter to the editor of your local paper about human responsibility with regard to beach health. This can include the following:
 - Your area may or may not have a program for monitoring the recreational water quality for beach health purposes. Why should such a program exist in your community?
 - Humans can change their behaviors to improve water quality. What should or shouldn't people do to help improve water quality?

Answers to Beach Mysteries

- 1. FACTS:** A high level of bacteria is not detected at the beach. A flock of seagulls lands on the beach to inspect some food and wrappers left behind by humans. A boat sails by in the distance. Two kayakers paddle up to the shore, which startles the birds. They fly away. Several hours after the seagulls arrived, water samples are taken. When they come back from the lab, results show there is a high level of bacteria in the water near the beach.

How did the bacteria get there? *After the gulls have eaten, they leave droppings behind on the beach. E. coli bacteria are found in human and animal waste.*

How can we help solve this problem? *Don't leave litter behind. Any litter can cause harm. Food litter attracts wildlife in greater numbers than might normally live at or near the beach. Wildlife waste may contribute to high levels at the beach.*

- 2. FACTS:** The beach is clean. High levels of bacteria are not detected. That evening, a heavy rainstorm takes place that lasts all night long. You decide to stay in, do laundry and wash dishes. Your family runs both the washing machine and the dishwasher. You listen to music while doing homework, then go to bed. The next day, the beach is closed because beach managers have received a call from the water treatment plant. Based on the call, the beach managers know there will be high levels of bacteria in the water.

How did the bacteria get there? *When a lot of precipitation falls, the water treatment plant may not be able to process and clean all the water as quickly as it accumulates. If this happens, water treatment plants may release untreated sewage into rivers, lakes and streams. E. coli may be found in the untreated sewage. This can cause elevated bacteria levels.*

What did the mysterious phone call tell the beach managers about why the beaches should be closed? *Beach managers are often notified of sewage overflows. This tipped them off that bacteria levels would be higher than usual.*

How can we help solve this problem? *Encourage your local municipality to make sure your water treatment facility is big enough to handle all of your community's water. Don't contribute extra water to the system during a heavy rain. This may mean waiting to run your dishwasher or do your laundry.*

- 3. FACTS:** A few friends meet on the beach in the morning to walk their dogs. The dogs run along the shoreline and into the water, fetching sticks for an hour. A jet ski zooms by in the distance and several motorboats pass by at high speeds. When the group with the dog leaves, there is dog waste visible along the water's edge. The next day, the beach is closed because the beach managers have detected high levels of bacteria at the beach.

How did the bacteria get there? *Dog waste may be contributing to E. coli or other bacteria in the water if the dog owners do not responsibly pick up after their pets.*

How can we help solve this problem? *Always pick up after your pet. Encourage other pet owners to do the same.*

- 4. FACTS:** During a walk around your neighborhood, you see dog waste on the ground, ants walking on the sidewalk and into the grass and hear birds singing in the trees. After it rains that night, the beaches are closed. You remember that the dog waste was not close to the beach, but in the grass across the street from it. It was not really a heavy rain, and you know that there was not a "sewage overflow," but there are still high levels of bacteria when the beach managers get the results back from a water sample they took after the rainy night.

How did the bacteria get there? *When rain reaches the ground, it's called stormwater. As it accumulates, stormwater flows to the lowest point. In a Texas community, this is often the coast. Stormwater carries bacteria and other pollutants from a variety of sources including fertilizers and waste from domestic and wild animals. Stormwater flows from the surrounding surfaces (streets, parking lots, lawns, agricultural areas) over sand and into the gulf or ocean, causing elevated levels of bacteria. Some coastal communities in Texas funnel storm water through pipes, called outfalls, which can contribute to the bacteria levels. Nationally, stormwater is the most frequent cause of beach closings.*

How can we solve this problem? *Encourage your community to incorporate "green spaces" such as rain gardens, wetlands, or a pond system near hard surfaces so the rain runoff can be absorbed and filtered instead of flowing directly into the coast. Other ideas include using hard surfaces that allow water to pass through (permeable paving) and planting native grasses in "green borders" around parking lots.*

Wrap-Up: Mysterious Bacteria Game

1. Students sit in a circle with their eyes closed. Choose one student to be the “beach bacteria.” Tap this student on the shoulder and have everyone re-open his or her eyes. The student uses the knowledge from the activity to decide what source s/he is from (sewage overflow, seagull waste, stormwater runoff).
2. Have students walk around the room, shaking hands with each other. When the “bacteria” student shakes hands, s/he squeezes the other students’ hand, indicating the spread of the bacteria.
3. When a student is “contaminated,” s/he dramatically falls to the ground, indicating sickness.
4. Other students can guess who the “bacteria” student is. If they are wrong, they are out of the game.
5. Once the student is identified, the other students can ask yes or no questions to determine the student’s selected source of contamination.
6. After the game, explain that it is currently very difficult to determine the source of bacteria in the water, much like it was difficult to determine which student was acting as the harmful bacteria and what his or her source was.

Extension

1. Research the status of recreational water quality in your area by inviting a beach manager as a guest speaker to your classroom.
2. Have students decide if they would like to take action to improve beach health in their community. If so, have them choose one or more of the following options:
 - Participate in the Texas General Land Office Adopt-A-Beach Program cleanups, which enable students to create positive change for their beaches through litter cleanups.
 - Turn the persuasive essays regarding beach health into a class “letter to the editor” for your local paper.

*The Texas General Land Office values your thoughts and feedback. Please provide information about any oversights, errors or omissions, as well as particular activities that students find interesting. Send comments to the Texas General Land Office Adopt-A-Beach Program at **beach@glo.texas.gov**.*

*Adapted with permission from **Great Lakes in My World**, a lesson plan created by the Alliance for the Great Lakes.*

Unit 4 | “Beach Mysteries” Journal Pages

BEACH MYSTERIES

Analyze the following facts to determine how bacteria got into the water. Then determine what can be done to prevent water from becoming contaminated in the first place.

1. **FACTS:** A high level of bacteria is not detected at the beach. A flock of seagulls spots some food and wrappers left behind by humans. They land on the beach to eat and inspect the garbage. A boat sails by in the distance. Two kayakers paddle up to the shore, which startles the birds. They fly away. Several hours after the seagulls arrived, water samples are taken. When they come back from the lab, results show there is a high level of bacteria in the water near the beach.

How did the bacteria get there?

How can we help solve this problem?

2. **FACTS:** The beach is clean. A high level of bacteria is not detected. That night a huge rainstorm takes place. It rains hard all night long. You think it is a great night to stay in and do laundry and your dishes, so your family runs both the washing machine and the dishwasher. You listen to music while doing homework, then go to bed. The next day, the beach is closed because the beach managers have received a call from the water treatment plant. Based on the call, the beach managers know there will be high levels of bacteria in the water.

How did the bacteria get there?

What did the mysterious phone call tell the beach managers about why the beaches should be closed?

How can we help solve this problem?

3. **FACTS:** A few friends meet on the beach in the morning to walk their dogs. The dogs run along the shoreline and into the water, fetching sticks for an hour. A jet ski zooms by in the distance and several motorboats pass by at high speeds. When the group with the dogs leave, there is dog waste visible along the water's edge. The next day, the beach is closed because the beach managers have detected high levels of bacteria at the beach.

How did the bacteria get there?

How can we help solve this problem?

4. **FACTS:** During a walk around your neighborhood, you see dog waste on the ground, ants walking on the sidewalk and into the grass and hear birds singing in the trees. After it rains that night, the beaches are closed. You remember that the dog waste was not close to the beach, but in the grass across the street from it. It was not really a heavy rain, and you know that there was not a "sewage overflow," but there are still high levels of bacteria when the beach managers get the results back from a water sample they took after the rainy night.

How did the bacteria get there?

How can we help solve this problem?

Unit 4 | “Beach Mysteries” Journal Pages

VISUAL PROBLEM SOLVING

On a separate sheet of paper, create and label a diagram that shows at least three ways bacterial pollution can get to the beach. Include solutions to the problems you indicate in the diagram.

FOLLOW-UP PERSUASIVE ESSAY

Write a persuasive essay or letter to the editor about human responsibility with regard to beach health. You may include the following ideas:

1. Your area may or may not have a program for monitoring the recreational water quality for beach health purposes. Why should such a program exist in your community?
2. Humans can change their behaviors to improve water quality. What should or shouldn't people do to help improve water quality?

[illegible]